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Towards a Theory of Peripheral, Early Stage Clusters

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Abstract

This paper attempts to contribute to a theory of clusters in the biotechnology sector with special reference to those operating at the periphery and away from major and established centres. We identify causes of delayed and stunted development such as inadequate institutional support, lack of networking, diverging perceptions and cognitive disagreement among major players in a cluster. The conclusions are formalised into six propositions. This research has implications for public sector policy and theory of peripheral clusters, thus enriching academic research which frequently concentrates on established clusters which have grown organically. New concepts of "general periphery" and "liability of unconnectedness" are introduced.

Keywords: biotechnology, cognitive community, cluster periphery, cluster branding, regional identity, public sector policy

JEL codes: O18 - Regional, Urban, and Rural Analyses < O - Economic Development, Technological Change, and Growth, O31 - Innovation and Invention: Processes and Incentives < O38 - Government Policy < O3 - Technological Change|Research and Development

Introduction

Clusters are central to regional and national innovation and competitiveness (SAINSBURY et al., 1999; THOMAS, 2000; ZECHENDORF, 2004). Academics and practitioners treat them as key to technological-scientific and economic competitiveness. This is evidenced not only by the increase in public policy assistance of promising regions, clusters and networks but also by the volume and variety of analyses of such locations (COOKE, 2001a, 2001b; LAGENDIJK, 2001; PREVEZER, 2001; GITTELMAN and KOGUT, 2003).

Research on clusters tends to be dominated by the investigation of "positive" aspects of cluster organisation. An early example is Porter's emphasis on the determinants of competitiveness, such as the involvement of companies, organisations and individuals in webs of collaborative interactions. Such issues still define the parameters of inquiry in this area. Prevalent is the analysis of various aspects of cooperation (MASKELL et al., 2006; MOLINA-MORALES and MAS-VERDU, 2008); innovation (MORENO et al., 2006; VIRKKALA, 2007; MOLINA-MORALES and MAS-VERDU, 2008; PREVEZER, 2008; QUÉRÉ, 2008; ROSIELLO and ORSENIGO, 2008); competitiveness (NORUS, 2006); and growth (GLASSON et al., 2006), among others. While academics tend to investigate successful and established clusters and rarely consider issues of cluster failure (BRESCHI et al., 2001), some academics working in the area discuss the compositional characteristics of emerging clusters (CUMBERS et al., 2007), peripheral clusters (LAGENDIJK, 2000, 1999; LAGENDIJK and LORENZEN, 2007) and less successful clusters (COMMISSION OF THE EUROPEAN COMMUNITIES, 2004). There are also occasional references to disagreement and "controversy" (TEIGLAND and LINDQVIST, 2007; FELDMAN and LOWE, 2008) and even politics (SUBRA and NEWMAN, 2008) in clusters. In spite of such growth and "maturation" of the area, analyses of failed clusters and

negative features of collaboration and growth are still rare.

The paper attempts to address the above mentioned gap by studying the obverse of what many papers on clusters do. The author investigates "peripheral" and developing clusters which are facing difficulties. It is argued that much can be learnt from analysing failed cases and negative aspects of cluster organisation and their functioning.

Recent empirical findings for four biotechnology clusters in the UK and Ireland provide an insight into cluster problems:

- lack of individual and collective agency;
- weak density and variety of relationships, actors, activities and resources;
- ineffective public sector and infrastructural support, coupled with "short-termism";
- absence of agreement among key actors about the nature and future direction of a cluster;
- poor reputation and image.

The conclusions are formalised into six propositions which contribute to a theory of early stage and peripheral locations but may also help managers, academics, public sector policy bodies and any other advice and support organisations to understand better the areas where early stage, developing clusters need assistance. New concepts of 'general periphery' and 'liability of unconnectedness' are also introduced to the literatures of clusters.

Of the four clusters analysed by the author (the South West of England, Central Scotland, Ireland, Oxford), the South West of England is the most obvious candidate for a "peripheral cluster". Even though there is a continuum of clusters in terms of the type and severity of the "problems" and issues that they face, the less successful clusters (the South West of England) can be

distinguished from the more successful ones (Central Scotland, Ireland, and especially Oxford).

The following definitions of key terms are being used:

- "Cluster" is a "critical mass" of organisations which inhabit a "particular location" (PORTER, 1998) and which are "mutually supporting", benefiting from unanticipated connections.
- "Cluster difficulties" are described in terms of low density and variety of formal and informal relations of the organisations and individuals in a cluster as well as the lack of variety of actors, activities, and resources in a cluster.
- "Cluster periphery" is defined with respect to the geographical location of the cluster in relation to major successful clusters as well as its reputation.

The discussion starts by reviewing relevant areas of research of clusters. Survey findings and interview comments made by managers, scientists, consultants and public sector managers during an empirical research are then presented. Five areas contributing most to cluster periphery and six propositions are introduced. Implications for theory development and practice are highlighted.

Interest in biotechnology clusters

Our research programme on established and early stage clusters builds upon academic and practitioner traditions on national and regional systems of innovation and national business systems (UNGER, 2000), networks (HÅKANSSON and JOHANSON, 2001), and clusters (LAGENDIJK, 2001, 2006; COOKE, 2001a, 2001b). It also reflects the increasing public policy

interest in nurturing clusters at the national (SAINSBURY et al., 1999) and EU level (COMMISSION OF THE EUROPEAN COMMUNITIES, 2002, 2004b).

Whilst clusters in general are of interest, the importance of biotechnology clusters is assumed to be even greater. KENNEY and PATTON (2005) note that biotechnology has received considerable attention in terms of its "spatial configuration". It suffices to mention ZUCKER et al.'s (2002) and ROMANELLI and FELDMAN's (2004) studies of life science and biotechnology aggregation and its consequences. However, analyses of clusters remain largely limited to the investigation of successful and thriving locations (LAGENDIJK and LORENZEN, 2007).

Our understanding of "cluster difficulties" and "cluster periphery" draws upon accounts of less successful, peripheral or failed clusters. Though "cluster periphery" is not always equated with "cluster failure" – the latter denoting more severe problems facing clusters when they fail to exist or when employment declines and companies exit while new start-ups are not recorded – studies of failed clusters may help to identify the difficulties faced by clusters and the factors which contribute to success. BRESCHI et al.'s (2001) case study of the failure of biotechnology in Lombardy is an atypical account of futile attempts to design a cluster. It is also interesting because BRESCHI et al. attribute failure to hindering institutional conditions such as inadequate and poorly coordinated state support, ill advised funding choices and corruption scandals.

The discussion of "cluster periphery" builds upon LAGENDIJK and LORENZEN'S (2007) discussion of "geographical proximity" and "organisational proximity" of peripheral regions. Arguments put forth by LAGENDIJK and LORENZEN have been applied, including that of the

relationship between periphery and geographic distance from major sources of knowledge. The extent to which non-core clusters can develop relations and knowledge links with "core" areas, possibly by utilising organisational channels and personal networks, is relevant. Development of peripheral locations may be assisted by generating local capabilities through "global connections" and local connections to institutions of knowledge dissemination and absorption such as universities.

In an attempt to explain the link between "periphery" and "proximity", LAGENDIJK and LORENZEN (2007) apply TORRE and GILLY's (2000) and TORRE and RALLET's (2005) concepts of geographical, social ("logic of belonging"), institutional ("logic of similarity") and organisational proximity (Table 1). Positions (1a) and (1b) of strong "organisational proximity" and strong "geographical proximity" facilitate innovation. They are also the positions which remain "too much hyped in the literature" (LAGENDIJK and LORENZEN, 2007: 460). The difference between position (1a), originally identified by TORRE and RALLET (2005), and position (1b), added by LAGENDIJK and LORENZEN, is the temporary character of collaboration and, hence, proximity. Position (2) is one of high level of coordination and is marked by strong organisational proximity and weak geographical proximity. Position (3) characterises economic activity in spatially integrated locations where organisations co-locate in order to benefit from the common exploitation of infrastructure and resources.

Insert Table 1 Here

Of interest to us is position (4) of weak overall proximity. This is what the author refers to as "general periphery". The brief mention of this position in LAGENDIJK and LORENZEN's

analysis was the starting point of this investigation of "cluster difficulties" and "cluster periphery". The rest of the analysis attempts to develop an understanding of:

- what exactly happens in position (4);
- why some clusters remain trapped in position (4) and do not progress beyond it.

The empirical research

Research set-up and the overall picture

Four clusters were empirically studied: Oxford, Central Scotland, the South West of England and Ireland (including Republic of Ireland and Northern Ireland). Of these, only Oxford figures prominently in reports, academic papers, and case studies (COOKE, 2001a, 2001b; ZELLER, 2001). Central Scotland, the South West of England and Ireland are rarely mentioned in the academic literature, practitioner reports and public sector policy documents. For instance, Central Scotland's place is marginal in the 1999 *Biotechnology Clusters* report compiled by the team of UK's Minister of Science at the time, Lord Sainsbury. The South West of England is even more side-lined in the report.

The empirical research consisted of the analysis of a survey involving 288 organisations in Ireland in 2001 and 1,236 organisations in the three UK clusters in 2005. During separate research stages, 29 in-depth interviews in Ireland in 2001 and 2004 and 23 in-depth interviews in the UK (eighteen interviews with practitioners in the South West of England and five interviews with public sector managers in Scotland and the South West of England) in 2005, 2006, 2008 and 2009 were carried out. The qualitative data used in this discussion were provided by key stakeholders in the South West of England's biotechnology sector such as service providers,

SME managers, scientists and consultants. They participated in telephone interviews which lasted between 35 and 63 minutes and during which information was gathered about the history, institutional frame, and resource composition of the cluster, its networking activities and its general traits (see Table 2). Interviews were also organised with public sector policy makers, lasting between 48 and 81 minutes and during which the findings from the earlier conversations with practitioners were discussed.

Insert Table 2 and Table 3 here

Select survey findings for peripheral clusters

Among the UK clusters, the Oxford cluster is clearly differentiated, in terms of its scale, maturity and importance, from the clusters of Central Scotland and the South West of England (Table 3, Table 4). There is a noticeably lesser variety of actors, organisations, activities and resources in the South West of England. The variety of organisations in Oxford and their involvement in equally diverse activities are easily contrasted with the absence of research establishments at phases of development close to commercialisation and knowledge transfer in the South West of England (Table 4). The South West of England's lack of clinical testing establishments and the small number of research establishments carrying out applied research, and not only blue skies research, are two particularly significant findings.

Insert Table 4 Here

We use five measures of innovation inputs and six measures of innovation outputs (Table 4) borrowed from analyses of innovation and clusters. They have been adapted from HAGE and HOLLINGSWORTH's (2000) combined input and output innovation measures, POWELL and BRANTLEY's (1992) input measures and KLEINKNECHT's (1996) operationalisation of innovation. By incorporating a variety of innovation measures – "number of patent applications", "new products and services brought/not brought to market", "investment in R&D staff and machinery" and the "generation of high-profile publications" and "conference presentations" – it was felt that findings would capture the contributions that clusters made to science, the economy and society.

The South West of England cluster does not match the profiles of the Oxford and Central Scotland clusters in terms of the number of innovation outputs such as new market offerings, number of scientific publications, number of patent applications and patents granted. The standing of the cluster of Oxford as a centre of knowledge generation and dissemination is confirmed, both in absolute terms and relative to the South West of England and Central Scotland. Oxford's readings for the measures of "Percentage revenues accounted for by new products and/or services brought to market in last three years" (t-test, sig. 0.425; 0.098), "Publications, in the scientific literature" (t-test, sig. 0.232; 0.199), "Conference papers and addresses" (t-test, sig. 0.171; 0.114), and "Patents issued" (t-tests, sig 0.006; 0.709) are higher than those of the South West of England and Central Scotland.

The only measure where the South West of England scores high is "New products/services brought to market". However, if this measure is analysed alongside it's the reading of the cluster for "Percentage revenues accounted for by new products and/or services brought to market in last

three years", the South West of England emerges as a cluster with a significantly weaker contribution to economic well-being (lesser emphasis on new market offerings) and a less noticeable impact on the scientific community (lower number of scientific publications and patents).

The high readings for innovation outputs of the Oxford cluster (see Table 4, output measures 1-4) cannot be explained in terms of higher innovation inputs only, because Central Scotland and the South West of England report high innovation inputs as well. The innovation investments (innovation inputs) made in the clusters of Central Scotland and the South West of England do not seem to have been successfully translated into innovation outputs (see Table 4, input measures 1-5 compared to output measures 1-4). The inability of these two clusters to translate innovation inputs into innovation outputs raises two questions discussed in more depth later in the discussion: firstly, if national and regional policy can successfully engineer high-tech clusters; and secondly, whether the expectations about the timescale of ROI (return on such innovation investments in clusters) may be unrealistic.

The last set of survey findings are about the level and type of networking of organisations that inhabit clusters. The level and type of networking are measured in terms of "centrality in webs of exchanges" (number of ties), "complexity of exchanges" (variety of exchanges), and "type of relations" (long term, value adding, knowledge-generation-and-exploitation-focused relations or the lack of such relations). There are significant differences among the three UK clusters with respect to their networking arrangements. The responses of the companies from Central Scotland indicate 'lower connectedness', or lower level of networking and centrality in the UK and international systems of biotechnology knowledge generation and dissemination. Such findings

also imply reduced influence of this cluster. Similarly, the South West of England compares unfavourably with the greater number of relations overall (t-test, sig. 0.534; 0.704), of regional relations (t-test, sig. 0.190; 0.081), and of international relations (t-test, sig. 0.213; 0.208) of the organisations inhabiting the Oxford cluster.

Empirical findings about cluster difficulties and cluster periphery

Three interview findings with a bearing on this discussion confirm the survey findings, as illustrated in Tables 3 and 4. These are "low level of agency", perceptions of "shortage of institutional support" for cluster development, and "isolation". Such findings draw attention to problems which may contribute to early stage "cluster difficulties" and "cluster periphery".

Area 1: Intra-regional networking, density and variety of relationships

Some interviewees attributed the problems of early stage clusters to inadequate local "connectedness". The hope for *future success* in this area was expressed by the MD of a provider of scientific-technological services) (interviewee # 8; date: 2006) who noted

things are growing in the South West ... we're not averse to having relationships with other companies... as their needs arise.

Another interviewee (interviewee # 3; date: 2006), a consultant working in the area, raised similar concerns regarding the lack of local initiative-taking, networking and the generation of a critical mass of relations among members of the cluster. Interviewees rarely mentioned intra-cluster transfer of knowledge. The few references to such issues (interviewees # 4, 9, 12; date: 2006) appeared only in three interviews and almost invariably focused on planned developments

and future initiatives rather than on present schemes. The manager of a company providing specialist chemicals (interviewee # 4; date: 2006) pointed out that

we are thinking of opening negotiations [with other companies] … *I would think that we would see a stronger relationship with other companies in the region.*

Recent interviews with a prominent scientist (interviewee # 19; date: 2008 and 2009) revealed that, while *there's potential*, their organisation had not adequately explored the possibilities of developing relationships that *could lead to something*. The same interviewee argued that universities and research institutions in the South West of England were increasingly inclined to move forward on their own, if they felt that they needed to proceed quickly on a project and were not supported by the national and regional development agencies in their efforts. The scientist conceded that regional development agencies and advice bodies had initiated schemes and had commissioned reports. Nonetheless, much of that activity allegedly had to do with

boasting about the figures and the metrics

and relatively less with *consulting* local players as to what they really needed.

Though of recent origin and inadequately researched, intra-regional networking was described by a public sector manager (interviewee # 18; date: 2008) as being *promoted* by the public sector. The interviewee was eager to emphasise that current efforts were being targeted at making up for the belated development of the cluster, including the promotion of industrial networks around BioIncubators and the organisation of events with the SW Angel Investor Network (SWAIN hereafter). This network is partly funded by the SW RDA and works closely with SW RDA with the objective of connecting businesses with private investors. Another prominent example discussed during two interviews (interviewees # 9 and 11; date: 2006) was the planned yet not

functioning Bristol & Bath Science Park 'SPark' which was described as *long needed*. Promising mentoring schemes, such as those run by SWAIN and BusinessLink (a free business advice and support service available throughout England), were assessed by an interviewee (interviewee # 19; date: 2009) as

not always targeted, at least that is how some clients feel ... [but] *probably useful.*

It appeared that the networking efforts of regional policy bodies and facilitators were frustrated by the lack of resources. The authority and powers of regional public sector bodies and related support organisations were described as largely *confined to brokering*.

Building upon the interview narratives and the survey findings for the three studied clusters concerning the density and variety of networking ties, and following BAUM and OLIVER (1992), we suggest that the empirical research provides a compelling illustration of what we refer to as "liability of unconnectedness". Its magnitude in the South West of England is comparable to the inadequate embeddedness and low complexity of relations uncovered for promising, technology-driven populations in the Irish biotechnology cluster and may be linked to the reported difficulties in accumulating regional know-how, innovating and commercialising inventions.

We suggest the following proposition:

Proposition 1: Cluster periphery and the absence of growth of early stage clusters are associated with unsuccessful attempts to develop local, dense and varied networks of actors, organisations and activities. Particularly important to stimulating the development of a cluster may be the existence of 'anchor' firms and research institutions.

Area 2: Extra-regional networking, density and variety of relationships

LAGENDIJK and LORENZEN (2007) maintain that organisations in "non-core locations" need to develop strategies to gain access to the expertise in core areas, by nurturing knowledge exchanges with them. The managers, consultants and scientists interviewed in the South West of England acknowledged that events, conferences, and workshops were being organised. Networks such as the Bristol Enterprise Network had been successfully set up, aimed at assisting networking within and outside the cluster. However, interviewees' reports of on-going, intensive networking with outside bodies were infrequent (interviewee # 2; date: 2006). The problems of poor networking appeared to be enduring (interviewee # 4, 9, 16, 19; date: 2006, 2008 and 2009). During some of the interviews (interviewee # 3, 8, 19; date: 2006 and 2009), the South West was contrasted with locations which had long standing institutions, established and recognised traditions in science and commercialisation of research, a variety of participant organisations and prominent actors working in biotechnology. This story of the *lack of success* in networking with colleagues outside the cluster was linked to a narrative (interviewee # 19; date: 2008 and 2009) about the *peripheral position* of the cluster and its *low visibility*. A mid-level manager of a production facility (interviewee # 11; date: 2006) repeatedly pointed out that companies in the region found it hard to develop contacts with *star scientists* and key multinational players. The manager suggested that

compared to Oxford and Cambridge obviously we've got a long way to go.

Similarly, the MD of a service provider (interviewee # 8; date: 2006) noted that biotechnology players at the international stage had to

understand that there are companies here that are progressing and it is an area of interest for them.

There was little disagreement about the peripheral position of the cluster internationally, with the interviewee noting that the cluster

doesn't ... rate at all really … I felt that scientific life more or less ended there [in the South West of England].

Problems may not be unique to the South West of England. When asked to reflect on their experience in another UK biotechnology cluster, a scientist (interviewee # 19; date: 2008) suggested that the start-up biotechnology company they used to work for faced similar issues when attempting to liaise with and attract venture capitalists. There was no expectation that current initiatives, at the time of the empirical research, such as the Trade Missions, the delegation to the US in late 2008, and the facilitation of meetings with scientists and managers outside the region would *work*, as locally available scientists with specific skills were allegedly rare and hard to persuade to stay in the region.

We suggest the following proposition:

Proposition 2: Cluster periphery and the absence of growth of early stage clusters are linked with insufficient or ineffective attempts to encourage networking with national and world-class centres of excellence in the global system of knowledge creation and dissemination.

Area 3: Cognitive disagreement and fostering a cognitive community

Social and institutional proximity (TORRE and RALLET, 2005) as well as cognitive proximity (BOSCHMA, 2005) contribute to the advancement or otherwise of clusters. There appear to exist problems related to cognitive proximity in the South West of England. The policy makers'

views of cluster success were challenged by all interviewed practitioners. Such divergence of views concerning the success of the cluster was uncovered during the interviews concerning the Irish cluster as well, but it seemed to be particularly pronounced in the South West of England. This conclusion about the disagreement among isolated "cognitive communities" rests not only on the empirical findings but also on general claims about the nature and communication limitations of "cognitive communities", "epistemic communities", and "communities of practice".

It is indicative that a public sector manager (interviewee # 18; date: 2008), when asked whether they thought that a strong identity existed among individuals and organisations as well as between the private and public sectors in the South West of England, suggested that shared identity was

extremely strong [but only] *among some organisations*.

One example provided by the manager was the *natural grouping* of the Plymouth Marine Sciences Partnership which unites seven organisations involved in marine biology research. The manager also suggested that the identity of such groupings had been actively promoted through *support of their work* and the generation of opportunities such as the aforementioned BioFlorida mission in October 2008. However, no other major examples providing evidence for the existence of a common, overarching identity of private and public sector organisations were found.

We suggest the following proposition:

Proposition 3: Cluster periphery and the absence of growth of early stage clusters are attributed to failed attempts to foster a "cognitive community" with collectively held perceptions being encouraged early in the history of the cluster.

Area 4: Visibility and periphery of clusters

Visibility and periphery are issues which dominated many interviews (interviewee # 2, 3, 4, 8, 11 and 12; date: 2006). The low visibility and inadequate place branding or cluster re-positioning initiatives were reported by three interviewees (interviewee # 11, 12 and 19; date: 2006, 2008 and 2009). It appears that there have been frustrated efforts to develop and diversify the portfolio of actors, organisations and activities in the South West of England. Interviewees (interviewee # 11 and 19; date: 2006 and 2009) linked this issue with the problem of developing a strong regional identity. This issue of identity of supra-organisational entities has only recently been analysed by Organisation Theory and Strategic Theory scholars (POLOS et al., 2002; RAO et al., 2003; HANNAN et al., 2004; HSU and HANNAN, 2005). Comments of

no meeting of minds, *different agendas* [of public and private sector organisations] and a *lack of collaboration* (interviewee # 19; date: 2008 and 2009)

between these two groups because of differences in perceptions can be interpreted using ROMANELLI and KHESINA's (2005) definition of "regional industrial identity" as a "social code" which affects economic decisions, if shared by stakeholder groups. ROMANELLI and KHESINA view the strength of such an identity as a by-product of the size and the number of observer groups which subscribe to a specific version of that identity. In the case of the early stage cluster studied here, shared popular perceptions are of an area of natural beauty, sparsely populated and without good infrastructure or links with the rest of the country. As described by

two interviewees (interviewee # 18 and 19; date: 2008 and 2009), it is a remote place which is seen as distinct from the bustle of modern life and from traditional centres of excellence in science and technology.

Partly in response to such widely held conceptions, regional public sector bodies appear to have made recent attempts to re-define the cluster identity and "re-brand" the area. The South West of England led the BioFlorida mission in October 2008, on behalf of all UK clusters. The area was also popularised during an April 2008 event in Exeter, with participants such as NHS Innovations SW and UK Trade & Investment taking part. A knowledge transfer network event was held in September 2008. In the opinion of one public sector manager (interviewee # 18; date: 2008)

One of the biggest hurdles is that the South West is seen as a holiday area – holiday destination.

However, concerted efforts were being made to place a series of advertisements and articles in industry trade journals attempting to place brand the area as a biotechnology specialist location. Even though the interviewee in question stressed

you need to raise awareness of your strengths and hold national meetings,

it was felt that perceptions were changing very slowly and only recently, partly because of the more recent efforts of public sector policy such as the promotion initiative of the region in the *European Biopharmaceutical Review*. The interviewees working in the private sector did not appear to be aware of these initiatives.

The realisation of the significance of the "periphery" problem is also reflected in recent public sector documents. SW RDA (2006a, 2006b) singles out the 'periphery' issue as problematic and has prioritised the need to "improve the way that the South West is perceived by investors,

businesses, potential workers and visitors" (2006b: 27). However, place re-branding attempts still focus on the tourist sector, creative and leisure industries, and not on biotechnology.

The survey findings and interview narratives raise a question as to whether it is possible to change long-standing and enduring perceptions. The narratives suggest that concerted efforts to re-brand early stage clusters may not produce the immediate outcomes which are often desired. To change long held perceptions concerning place brands is notoriously difficult. Collective perceptions are path-dependent and resilient to overt influence. Therefore, policy efforts may need to be long-term and not based on the frequent and periodic evaluation of short-term deliverables (the *public sector short-termism* referred to by interviewee # 19; date: 2009). Furthermore, as interviewees (interviewee # 8, 11, 12; date: 2006) suggested that national place branding programmes designed in London appeared to sideline developments in the South West of England, place branding programmes may need to be designed without expectations of active involvement on the part of national public sector bodies. As demonstrated by recent branding initiatives such as placing advertisements internationally, modest promotion may need to be taken to gradually manipulating – in the positive sense of the word – the reputation of a cluster rather than wait for the attention of and a more favourable attitude on the part of the national administration.

We suggest the following propositions:

Proposition 4: Cluster periphery and the absence of growth of early stage clusters may be associated with failed attempts to address visibility issues and re-position a cluster, both internally in the region and internationally.

Proposition 5: Cluster periphery and the absence of growth of early stage clusters may be linked to failed attempts to agree on a clear identity for the cluster and nurture shared understandings of a "desirable" cluster "identity".

Area 5: Regional and local support; the role of institutions

The dissatisfaction with the rate of growth of the cluster, number of new ventures, and the absence of success stories was frequently associated by interviewees with the inadequate support of regional and especially national development agencies. This matter of institutional support and infrastructure, in terms of the provision of funding, business and technical assistance, the assistance for key institutions such as universities, research establishments, teaching hospitals, and suitably trained labour ranging from technicians and managers to star scientists was recurrent across interviews (interviewee # 2, 4, 9, 12, 18, 19; date: 2006, 2008 and 2009).

Some respondents (interviewee # 18; date: 2008) identified regional policy initiatives aimed at encouraging the creation of new ventures and assisting the actions of local managers and scientists, but the majority of interviews revealed a pronounced frustration with the focus at the *Government level* at what the interviewees referred to as the

South East [England] *and the golden triangle* [of London, Oxford and Cambridge] (interviewee # 8; date: 2006)

Respondents (interviewee # 8, 11, 12; date: 2006) repeatedly drew attention to the unsuccessful efforts to involve national policy makers in regional schemes of company financing and creation, specific project backing, relationship generation and nurturing.

Even though certain problems did not actually appear to be in the remit of regional development agencies, interviewees (interviewee # 8, 12; date: 2006) stated their dissatisfaction with the reticence of regional public sector policy bodies to make referrals, their limited autonomy and decision making power when approached regarding specific projects, the low responsiveness on the part of agencies and London-based agencies in particular, their alleged

inertia in thinking inherited from the Thatcher period (interviewee # 12; date: 2006)

and its bias towards established and mature service sectors with business models inappropriate for small-scale biotechnology companies, the limited experience with biotechnology and the resulting lack of understanding of scientists' and service providers' needs (interviewee # 12; date: 2006). One respondent stated that when useful support was provided, it was done *in a very round about way* (interviewee # 11; date: 2006). A local consultant (interviewee # 3; date: 2006) remarked

They lack the physical sciences background to understand... what I'm doing really – … so from my perspective they're neither intellectual heavyweights on the science side nor do they have – you know – 25 or 30 years of business experience.

With respect to the efforts on the part of regional development and advisory agencies, a scientist (interviewee # 19; date: 2008 and 2009) noted that their relatively short planning cycles and time frames were at odds with the long-term frames in biotechnology. Such short-termism, it was suggested, affected biotechnology programmes and the overall development of science in the cluster. The same interviewee clearly distinguished between the role and impact of regional and national policy bodies. It was noted that SW RDA had sub-regional teams linked closely to universities, Innovation Centres, and Local Authorities. The frustration with London-based public sector decision making was obvious when the interviewee added that

The South East gets a lot of focus, due to the many multinationals in the pharmaceutical industry. The DTI work with the multinationals, not with small companies and many of these MNCs happen to be in the South East.

Further evidence of such a bias, on the part of the national development bodies, is found in publicly available documents. According to UK Trade & Investment (2007), the Marketing Strategy Board is a pillar in delivering the new marketing strategy across sectors in the UK. The author has discovered that the South West of England and small players in biotechnology seem to have been sidelined from membership on the Board.

The literature tells us that institutions affect local dynamics and cluster survival (BRESCHI et al., 2001). The absence of local institutions and support may negatively affect cluster growth, as illustrated in the limited and fragile webs of knowledge creation reported by BENNEWORTH (2007) in the case of Newcastle University. Fostering cluster development is also influenced by the degree to which national policy has shifted from the traditional focus on large enterprises and towards assisting dynamic SMEs and entrepreneurship (AUDRETSCH, 2002; GILBERT et al., 2004; SOETE and STEPHAN, 2004). In this transition from a national to a local policy model, some clusters seem to have lost out to "winner regions" with traditional, long term and long standing advantage in the natural sciences.

We suggest the following proposition:

Proposition 6: Cluster periphery and the absence of growth of early stage clusters are associated with public sector policy emphasis on "winner regions" and "national champions".

Towards a theory of peripheral, early stage clusters

This discussion built upon current critique in the literature of clusters, more specifically in "new regionalism" research (LOVERING, 2001, 2007; LAGENDIJK, 2006; MACLEOD and MARTIN, 2007), and identified factors behind the hindered development of clusters. The author has suggested five areas of cluster formation difficulties and cluster periphery which can "make or break" an early-stage, developing cluster. This presents an alternative approach to the analysis of factors which are associated with successful clusters. Here the inductive propositions are extended. The aim is to contribute to the development of a body of knowledge of peripheral clusters and define the essential parts of such knowledge (Figure 1).

Insert Figure 1 Here

Propositions 1 and 2 suggest that early-stage cluster difficulties and periphery may be attributed to the unsuccessful attempts to develop local, dense and varied networks and to stimulate links with national and world-class centres of excellence as well as professional bodies located far from the cluster. However, the question remains as to why clusters such as the South West of England do not develop these dense networks internally. Survey findings and interview themes hint to problematic areas. One is the absence of 'anchor' firms in pharmaceuticals, medical device, diagnostics and other sectors of the life sciences. Not having such companies in an emerging cluster almost invariably hinders the development of SMEs. The absence of anchor multinationals, bringing in established links with their parent organisations and other companies, coupled with the scarceness of ties (i.e. low number of ties per organisation) with pharmaceutical and medical device multinationals outside the cluster, does not provide opportunities for local actors to connect with "externals". As suggested by an SME manager (interviewee # 4; date:

2006), this presents problems in terms of *access to people* including managers, scientists, technicians and subcontractors with valuable and specialised expertise. In fact, the South West of England has recently lost multinationals previously located there which one interviewee (interviewee # 19; date: 2009) attributed to inadequate subsidies and incentives. Though not directly related to our research, an example that appeared during the interview sheds light on some of the difficulties in attracting and keeping such companies. Amazon had had a distribution centre in the South West of England which was recently moved to Swansea in south Wales.

There's a need for a big incentive for someone to come here

a scientist argued, adding that

The South West isn't the first calling point to come to … you need to engage their interest, especially if they don't know who you are

which, according to the respondent, contrasted with the carefully planned and executed provision of incentives for Amazon to relocate to south Wales, much owing to the clear project commitment of the Welsh Assembly Government.

Far from being able to attract and embed anchor multinationals, the South West of England has lost key "anchor" SMEs. These businesses include knowledge-intensive and technology-intensive micro-companies and spin-outs that have either left the region or have gone bankrupt. Such loss may cripple early-stage, peripheral clusters in the long-term, for even though the literature often assumes that only multinationals can play the role of anchor companies, dynamic and innovative SMEs are often the engines of technological and scientific growth. In the words of a manager (interviewee # 15; date: 2006), such SMEs can help

a good network get going, by combining and bringing together commercial inputs, institutions like the NHS, and scientists.

By contributing to the generation of a critical mass of basic science and by actively commercialising science, they also tend to attract representatives and distributors of multinational companies. In the absence of such SMEs, it may make no economic sense for such distributors and representatives to locate in the region.

A mid-level manager (interviewee # 17; date: 2009) in a service provider pointed out that

A couple of years ago I attended an evening meeting at Bristol University highlighting some of their spin-outs, which gave some encouragement, but then I noticed that one of the most prominent companies migrated to Cambridge a few months later.

A scientist (interviewee # 19; date: 2009) discussed two prominent chemistry SMEs companies that had gone out of business, generating "a vacuum in bespoke and combinatorial chemistry". The first SME had closed down recently, while the second, owned by a US multinational, allegedly disbanded the team and

took the technology back to the US as it *saw no opportunities* [in the South West]

prompting the interviewee to add that the cluster *has regressed*.

The author links this absence and loss of promising anchor SMEs to three issues. Firstly, they help explain the relative isolation of the scientists in peripheral clusters from *the commercial world*. Secondly, if these anchor SMEs are not indigenous companies but are subsidiaries of multinationals, they may focus on retaining relations with the parent company and do not get adequately embedded in the cluster which is a development noted by us with respect to the Irish cluster discussed in an earlier publication. Thirdly, there is a danger that such non-indigenous SMEs may withdraw back to base, especially in hard times, as there may be little embedded value as such in being in a peripheral cluster which has been formed mainly on the basis of

subsidies provided by a local development agency. Nurturing and retaining local and promising SMEs at various stages of their development is vital but may prove difficult, as the specific case of the peripheral cluster demonstrates.

Peripheral clusters also appear to suffer from the absence of experienced service provision SMEs that assist scientists, connect them to other businesses and also instruct them in areas of manufacturing, supply chain management, project management, and marketing. These fundamental services are often overlooked by scientists who expect that their reputation in scientific circles will automatically ensure successful commercialisation. Direct and proactive involvement may be needed on the part of public sector policy in assisting such SME specialist service providers to help address resource inadequacies in early-stage clusters. These should include but not be confined to relationship management, informal networking (habitually neglected in formal analysis) and trust building (see also LEAMER and STORPER, 2001; MORGAN and HUNT, 1994; NOOTEBOOM, 1996) especially when approaching integrated, diversified manufacturers.

The absence of anchor firms of various sorts in the South West of England, with established linkages outside the cluster, may be partly explained by the fact that the only historical infrastructure inherited by the biotechnology companies is engineering, with an emphasis on supplying the Navy. Such inheritance is inadequate, as the infrastructure provides few directly transferable skills. More importantly, though, the absence is also attributed to the entrenched nature of multinationals such as the big pharmaceutical companies. The South West of England has neither the

ready supply of highly qualified and low cost graduates of India and China

discussed at length by one interviewee nor *the tax incentives of Ireland* (interviewee # 19; date: 2009)

This issue of "full competence" clusters (ROSSON, 2003) requiring the presence of anchor organisations, upstream and downstream actors such as suppliers and distributors is also one of power and the lack of local capacity. The author believes that the case of the South West of England presents empirical backing for both claims. Private sector interviewees consistently singled out the lack of "proper commitment" among the underlying reasons for the inability of the South West of England to develop dense networks internally which is a question of the lack of critical mass.

There doesn't seem to be much happening on the ground level

a mid-level manager (interviewee # 11; date: 2006) contended, mainly because of the inadequate academic base in the region. In Oxford, the interviewee added, a large number of academics worked on projects and commercialisations. The underlying biochemistry basis in the South West of England, on the other hand, was described as *extremely limited*, with a weak chemistry culture, a lack of high quality and small volume chemical production, and no adequately resourced research institutions. An interviewee (interviewee # 19; date: 2009) pointed out that the key input of critical intellectual mass was missing. Intellectual fervour, in terms of the number of scientists and technicians and also with respect to the variety of ideas, was also often absent.

Periphery also means that some clusters find it difficult to attract not only star scientists but also early stage scientists and mid-level managers. This question of power, among other things, was revealed in the story of a company in the South West of England which attempted to attract a

mid-level manager, as noted during an interview (interviewee # 19; date: 2009). The company discovered that there was

the problem of someone wanting to come to green pastures.

The company had to compete with the

opportunities in the South East, even if your company fails.

This inability to persuade capable cadre to move to peripheral locations has to do with the paucity of opportunities in such clusters. The possibility to recombine resources, even when a new venture fails in an established cluster, is obviously absent in a peripheral cluster. Additional deterrents to attracting scientists, managers and clinical staff to the region have to do with family considerations.

If you're in your mid-to-late 40s [manager], a scientist (interviewee # 19; date: 2009) commented, *you take into consideration the effect that relocating to South West England may have on family members.*

The scientist provided an example of a mid-level manager who moved to a promising company in Central Scotland but had to move south again, as his children found it difficult to adapt. The absence of local opportunities for family members, the interviewee noted, means that

you can't necessarily rely on managers from outside the cluster.

This appears to be frequently misunderstood by the general public and the development agencies. They assume that tourist areas provide an appropriate and desirable place to live permanently. This may not always be the case, especially if the cognitively and socially peripheral cluster is also geographically peripheral (isolated), as is clearly the case with the South West of England. Last but least, such geographical isolation may negatively affect not only the spouses and children of potentially valuable individuals (scientists, technicians, managers, etc.) but also the prospects for promotion for the scientists and managers.

Propositions 3, 4 and 5 identify additional inhibiting factors for peripheral clusters, more specifically the absence of a cognitive community and shared understandings of a common cluster identity, both among members of the cluster and by players outside of the cluster such as the public sector, the private sector and the general public. These need to be discussed with a view to the role of the public and private sector in encouraging proximity as well as the role of agency. This is a topic which was already noted with respect to Propositions 1 and 2. The section on empirical findings discussed at length the role of the public sector. Here the author emphasises investment in networking and infrastructure, marketing a cluster, and mechanisms for fostering a cognitive community. These are areas where regional and especially national public sector agency and involvement may be critical to early stage and peripheral clusters.

Our understanding of state involvement in developing a cognitive community and thus fostering the development of peripheral clusters goes beyond PORTER's view that the state only needs to ensure that the basic requirements such as input factors are in place. The survey findings clearly demonstrate that at least some of the input factors at the level of the individual firm are as adequate in the South West of England as they are in Oxford. Interviewees consistently emphasised that input problems were at the level of the cluster and not at the level of the individual companies, as measured by the survey and as reported here. Examples include investments in knowledge and not only in physical infrastructure, such as first class universities, a mass of

intellectuals [scientists] *who are prepared to be entrepreneurs, specialised labs and science parks*. (interviewee # 17; date: 2009)

It appears that public sector policy makers do not recognise the importance of the aspects of cluster development discussed above which are less frequently associated by policy makers with the development of peripheral clusters but which are precisely those clearly missing in the case of certain early stage locations. For instance, there is failure to consider the role of knowledge infrastructure, resources, and regional and place branding initiatives. Such initiatives may need to be designed by speaking to private sector actors like those studied and interviewed here and by asking them to identify deficiencies in terms of the support provided by RDAs, in light of the remit of regional development bodies and the instruments available to them. Furthermore, it seems that lessons from other locations and the manner in which they have dealt with "inhibiting ingredients" such as distance, remoteness, scarcity of resources, lack of history of industrial infrastructure and local entrepreneurship (i.e. Northern Finland) have not been studied by public sector bodies in the UK. While Scotland seems to have marketed itself successfully in the US and has attracted a number of large companies to base their headquarters there (interviewee # 19; date: 2009), the South West of England has failed in doing this.

Proposition 6 emphasises the effect of the public sector bias towards winner regions and "national champions" on the difficulties and periphery that some early stage clusters face. We link this proposition to initiatives in the South West of England noted by interviewees which have been allegedly hindered by the recent and inadequate transfer of powers from the national to the regional public sector bodies supporting biotechnology (interviewee # 8; date: 2006). The lack of initiative-taking may thus be attributed to the unclear boundaries of obligations and expectations towards the national and regional bodies, as suggested by a number of interviewees (interviewee # 8, 9, 12; date: 2006). Similar are the stories of

only initial contacts [developed, with] *lots of meetings and sub-groupings in SW RDA, meetings with stakeholders*

and no outcomes (interviewee # 19; date: 2009). Such comments are frequently accompanied by comparisons with Scotland and Wales where significant funding has been made available for the development and commercialisation of new technology. Emerging clusters in England, we were told, struggled with the effect of national level decisions, more specifically with the lack of freedom of regions to set up financial incentives autonomously.

The proposition also raises the issue of the (im)possibility of developing a cluster, especially in locations where an adequate skills and knowledge base may not exist, where anchor firms are not present, where useful resources have not been inherited from other industries that have populated or continue to populate a region, and where regional initiatives are limited and hindered by national decision making. This is particularly true for the South West of England which has not got a long-standing history of accumulation of expertise and resources in any of the areas of the natural sciences, even though the SW RDA takes pride in the alleged heritage and history of the region as a centre of engineering excellence in the UK.

Conclusion and Avenues for Future Research

Though based on a limited number of case studies, the discussion filled a gap in analysis about struggling locations. Rather than contributing to the identified "positiveness bias" in the area of inquiry, the paper analysed the less often researched "negative" issues of cluster failure, emerging, peripheral and less successful clusters.

The author suggested a body of knowledge about the drivers of cluster periphery, including the absence of anchor firms and incentives for attracting them, loss of anchor SMEs, inadequate or inappropriate inherited infrastructure, lack of local capacity in basic science, and difficulty in attracting star scientists and managers. Private sector managers and public sector officials may also be interested in lessons such as the recommended drive away from the present, rather limited understanding of cluster development, the exclusive focus on input factors, and the failure to apply lessons from other locations which have had to struggle with similar problems.

The future development of such a theory will depend on the refinement of the concepts and arguments presented here and on empirically testing them across sectors, contexts and stages of cluster development. The author invites scholars to study in more detail the role of individual and collective (private and public sector) agency in such clusters, and more specifically:

- role of anchor indigenous SMEs and the impact of their death or migration to other locations;
- balance of power between regional and national policy, and making best use of EU regional policy initiatives which aim to develop 'fringe' and 'Objective 1' areas of the EU some of which are also the areas where peripheral clusters are located;
- effectiveness of place branding. In spite of specific examples of place branding being provided and incorporated in this discussion, much remains to be written about this exciting topic, especially with respect to emerging clusters.

We conclude by suggesting two additional areas of future research. Firstly, there is a clear distinction between "cluster periphery" and "cluster failure". Peripheral clusters differ from failing ones mainly because they may still function relatively well. Even though they may not be

on the scale of Silicon Valley or Oxford, they exhibit corporate activity. Cluster failure instead is indicated by symptoms such as declining employment, company exits, and few start-ups. While this discussion analysed periphery, questions to be conceptualised and empirically examined include differences between "cluster periphery" and "cluster failure", implications for theorising different types of proximity, and implications for public sector support. Secondly, the research provided some empirical evidence for the various types of proximity. It demonstrated the role that social, institutional and cognitive proximity played to the advancement or otherwise of clusters. Further empirical evidence may be needed in order to test the proposition that a failure to develop a cognitive community means that a successful cluster also fails to develop.

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TABLE 1.

PROXIMITY AND PERIPHERIALITY OF CLUSTERS

Geographical proximity	Organizational proximity	
	Strong	Weak
Strong	(1a) Local systems of innovation/production (1b) Temporary co-localization	(3) Co-location without (*direct*) interaction
Weak	(2) Non localized interactions	(4) Activities in isolation

(LAGENDIJK and LORENZEN, 2007: 461).

TABLE 2.

SOUTH WEST ENGLAND BIOTECHNOLOGY

Location and numbers of biotechnology organisations in SWE	
Bristol	26
Salisbury	16
Plymouth	13
Exeter	8
Somerset, other	14
Devon, other	10
Cornwall, other	8
Dorset, other	8
Wiltshire	8
Gloucestershire	6

(BIOAPPROACHES SOUTH WEST, 2005).

TABLE 3.

SOUTH WEST ENGLAND BIOTECHNOLOGY

Key demographic traits of biotechnology organisations in SWE	
Average age	14.8 years
Average size (#employees)	168 employees
Organisations with 250 or more employees	4
Organisations with turnover of GBP 20m or above	2
Supply chain composition of organisations (number of companies):	
Manufacturers	7
Research establishments (basic research)	2
Research establishments (applied research)	5
Research establishments (clinical trials)	0
Service providers	12
Suppliers, distributors	4
Sectoral composition of organisations (number of companies):	
Agriculture	1
Bioinformatics	0
Chemicals	2
Diagnostics	2
Environment/waste management	3
Finance provision	0
Food & Drink	0
Governmental agency, NGO	1
Independent research centre	2
Medical devices	0
Pharmaceuticals/healthcare (therapeutics)	1
Research hospital	8
Support (legal, consultancy, business)	0
University department	7
Veterinary	2

(Source: Survey findings of the authors).

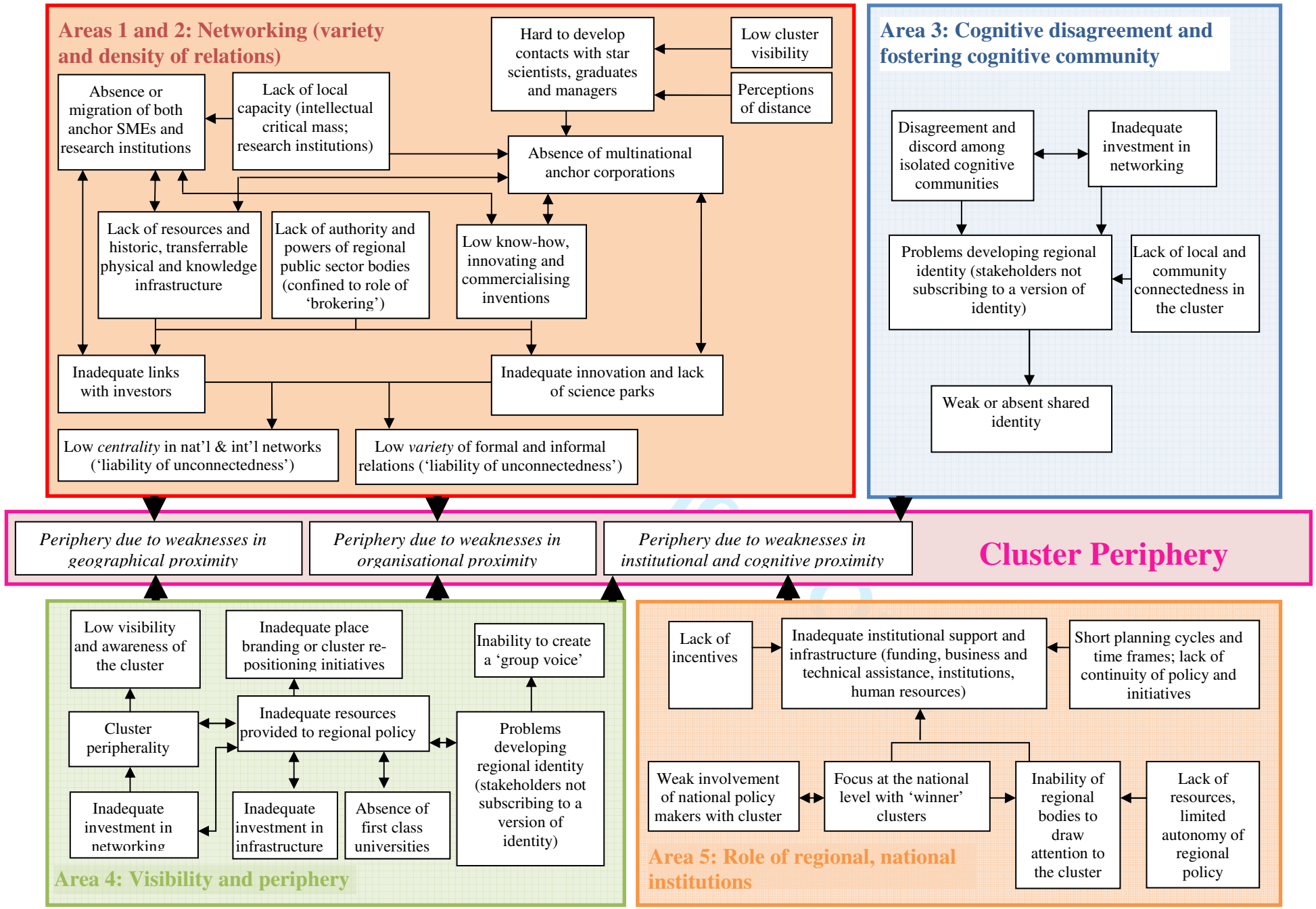
TABLE 4.

INNOVATION OUTPUTS AND INPUTS FOR BIOTECHONLOGY CLUSTERS (2003-2005)

	Oxford (n=56)	Central Scotland (n=77)	SW England (n=32)
INNOVATION OUTPUTS:			
Percentage revenues accounted for by new products and/or services brought to market in last three years	50.9	37.2	38.3
Publications, in the scientific literature	571.3	23.8	55.9
Conference papers, addresses, etc	83.3	9.9	13.7
Patent applications	9.3	6.3	6.6
Patents issued	4.4	3.6	1.7
New products/services brought to market	21.9	9.4	32.3
INNOVATION INPUTS:			
Percentage of total salary expenditure on research staff	45.7	37.7	38.1
Percentage total training expenditure on research staff	31.8	36.1	30.5
Training expenditure as per cent of total revenue	11.6	7.68	8.60
Percentage staff holding first degree or higher	48.2	46.4	45.4
R&D and engineering spend as per cent of total revenue	26.8	32.9	31.0

(Source: Survey findings of the authors).

FIGURE 1. FACTORS FOR CLUSTER PERIPHERY *



* Five areas affect 'cluster periphery', itself positioned in the middle of the diagram.